MODERN Machine Shop

HOWARD CAMPBELL, Editor

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SEPTEMBER, 1933

CINCINNATI, OHIO VOL. 6, NO. 4

Die-Casting Leads to Reduction in Manufacturing Cost

BY H. K. WOOTON

DIE-CASTING is constantly becoming a more essential and economical adjunct to a manufacturer in whose plant a quantity process production is carried on. The process involves the introduction of molten metal into a permanent mold which, of course, can be renewed when necessary so long as the original lasts. Authorities generally agree that there are many machining operations that can be superseded or speeded up by the use of die-cast parts.

There are many varieties of dies produced for every use to which they can be adapted, but only those which can be produced in non-ferrous white metal alloys will be treated in this article. First, there is the permanent mold of gravity casting, in which the die is usually made so as to be entirely collapsible, being built up in sections, dowelled and locked together. The die is wholly dismantled in removing the casting and is re-assembled for the subsequent casting.

Runners or ingates are provided for introducing the metal, which is usually poured from hand ladles.

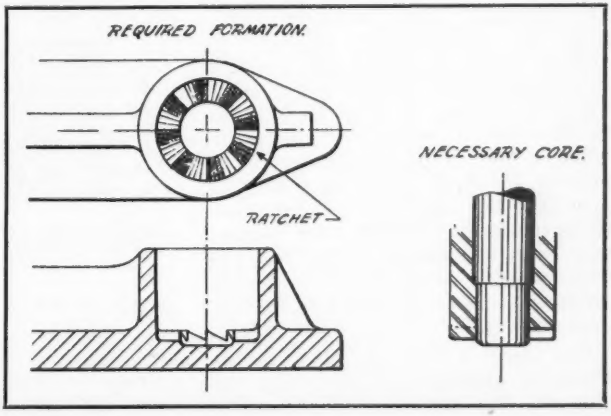

Fig. 1—Drawing of part in which a ratchet is to be cast.

Risers are placed at periods to serve as feeders, as in ordinary foundry practice. This style of die is generally given an initial heating before the first of the day's cast is poured, being maintained afterward at its

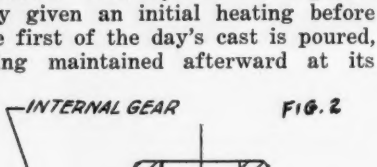

Fig. 2—Cross-section drawing of an internal gear in which the teeth are formed by casting.

working temperature partly by use of heating devices and partly through the heat which is added by the inrush of molten metal. Use of gravity die-casting is general on high melting point alloys, including brass, aluminum-bronze and aluminum-copper.

More speedy methods of operating dies are available for the second type of die-casting. Production here is usually by machine, the molten metal being forced into the dies, usually at an extremely high pressure. This plan is successfully applied to aluminum-copper alloys and is used to a considerable extent on low melting point alloys. It must be brought to the correct working temperature when a run is beginning, but as a general thing, it is not necessary to provide other means of heating than those obtained through the normal way from the casting. This method of working is so rapid that it is very difficult to keep the dies cool enough even with low melting point alloys.

Considerable time is spent, before a run is obtained, in arranging the dies on the machines, determining temperature conditions of the metal as well as the dies, and arranging quick-acting devices for whatever moving parts there are of the die, as well as any special clamps or locks that may be needed for the machine. It is essential that continuity should be maintained to reap whatever benefit may develop through the saving shown by the die process, since the minimum time for operating is really found only after the first few hundred castings are made.

Various costly machining operations are involved, usually, when a considerable quantity of a complicated part is made by ordinary methods. In this event, jigs, fixtures and special tools are necessary and even when all this has been provided, a tiny imperfection may develop, thus upsetting all plans and delaying the operation.

Absolute uniformity cannot be claimed for all die-castings; certain inaccuracies are apt to crop out no matter how perfect the die may be. Even with the best of die-making equipment in the processes of casting, turnings, milling, shaping, and so on, and even with the most experi

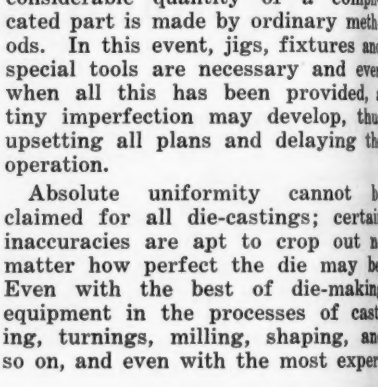

Fig. 3—External thread, produced by die casting.

planning, a careful watch has to be kept for imperfections which may bring about a lot of trouble when the casting is being assembled. Inspection will eliminate the imperfect pieces, but plenty of harm may be

done before the inaccuracies are discovered.

The best method for die-making is, of course, to have a master mold made of a permanent metal. Whatever variation is likely to take place in a die produced in this way will come about only through the "spring" of a portion of the mold, or in the temperatures of the metal which may affect the die. An allowance made at the very start will usually meet the exigencies of the first occasion, and proper control will minimize the second.

It is necessary that the highest degree of skill be applied to the fashioning of the die, because the question of accuracy with the best types of die-casting alloys and the amount of known shrinkage is resolved into this particular essential. Preservation of the accuracy of the die, of course, depends upon how it is designed, made up and the amount of usage to which it is subjected, and whether the metal used has any soldering effect or takes any erosive action on the material from which the die is made. For example, if cores are placed in juxtaposition to the initial inflow of hot metal, they will require renewing periodically, this depending, however, on whether metal of high or low point is adopted. Very little wear ever occurs on the main die formation where white metal alloys are used. In fact, it seems that the only obstacles to perfect maintenance of the die arise through peculiarities of the material used in the die.

The casting properties of a perfect die may be illustrated by the following: During the World War, a certain section of a hand grenade was die-cast by the million. When the armistice came, the number of dies on hand was 21, and 14 of this number had been kept constantly at work. Each die contained eight formations. The total quantity of hand-grenade parts made by these dies was between 37,000,000 and 38,000,000, and it is estimated that each die, with the small renewals necessary now and then, must have experienced around 22,000 casts. At the present moment the writer knows of two dies that are used in the production of a complicated casting of a speedometer casing from which more than 180,000

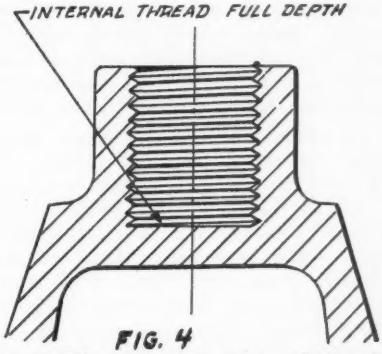

Fig. 4—Either external or internal threads full to the shoulder can be die cast.

casts have been made. There is only one die formation in this case.

The first essentials in the making of a die for die casting are, of course, the design and construction. The die must contain a negative formation of the casting required, or, in other words, wherever solid metal is necessary in the casting there should be corresponding space in the die, and for all spaces or holes that are required in the casting, there should be solid cores or metal in the die.

Attention is called to Fig. 1, which illustrates a blind hole in a piece upon which a ratchet formation is required on the bottom face. The problem of making a die to produce this casting presents no difficulty to the expert machinist, all that is required being to reproduce a negative of the necessary ratchet on the end of the

core. Figure 2 illustrates an internal gear formation with shrouded teeth at the blind end inside, which problem is met in much the same way as is indicated in Fig. 1. Internal and external threads, such as those shown in Fig. 3 and Fig. 4, can be cast up to a shoulder very easily, since they can be formed upon a plug or pair of slides of a thickness exactly equal to the length of the threaded portion. Holes of any required shape or formation can be readily reproduced by means of this process, the negative of the desired formation being formed in the cores.

In cases where parts made from other materials are to be incorporated into the castings, means are provided for locating such parts in the die and casting onto or around them. This method obviates the necessity for fastening connections. Such other materials used in this way may include brass, steel, iron, and so on. Sections of pole irons have been cast in magneto bodies, brackets cast on long tubes and rods, gears cast onto shafts for light duty work, bronze bushings cast into parts where they are required, and so on through a great variety of examples. Provision should be made in all these instances, however, for keying these "inserts" into the casting, so that they are firmly gripped as well as being further held by whatever shrinkage there is in the metal.

Parts that are used without much machining—in the rough state, as it were—should not be die-cast, since, when considered weight for weight, die-casting alloys cost much more than the more common kind of foundry materials. All undercut internal formations should be avoided, because of the difficulties found in the effort to extract cores after a casting is made. Collapsible cores are generally expensive, too. In order to facilitate die-casting of certain parts, sometimes modifications or slight changes in form will be found desirable because the designer is not sufficiently familiar with the process. To get the best results, the designer and die-caster should co-operate to the fullest extent.

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Calculating Feed Gears for Helical Hobbing

Here is a short cut in the method of calculating feed gears of a hobbing machine when helical gears are to be cut. While having no value for figuring single set-ups, it becomes very useful when figuring a number of gears having the same pitch and angle—or even when only the angles are alike.

By Arthur E. Plueddeman

THE formula given here for calculating the feed gears of a hobbing machine when helical gears are to be cut is not in the strict sense of the word a new formula; rather, it is a shortening of the usual method. The writer has, however, used the formula successfully for several years, in some instances reducing to minutes calculations which would ordinarily require hours. The method has a number of advantages, one of which consists in that a different set of feed change gears for the cutting of helical gears, to either increase or decrease the rate of feed, can be calculated in from one to two minutes.

By the use of this method, one multiplication is eliminated and hence the numbers for division are smaller. The method is especially useful where more than one gear of the same pitch and helix angle are to be figured, as one right hand and one left hand gear. The bulk of the time is saved on the second gear and subsequent gears. The method will be found valuable where many gears of the same helix angle are to be cut in different pitches. This statement will be illustrated by an example later in the article. The method assures a perfect bearing, as the allowable error will be exactly the same on both right and left hand gears.

The writer has used the formula successfully in connection with the operation of Barber-Colman, Gould & Eberhardt, and Lees Bradner hobbing machines, and doubtless it can be applied with equal success on any other spiral or helical hobbing machine that depends on a series or train of gears to give the correct lead. The use of the formula in connection with the Barber-Colman machine will be considered first.

The constant is the only part of the feed change gear formula that can change when a change is to be made in the number of teeth that are to be cut. Therefore, the feed change gear formula can be separated into two parts. One part will consist of $\frac{1}{\text{constant}}$, the other will be $\frac{\text{Normal Circular Pitch}}{\text{Sine Angle X } 0.075}$. This latter part we will call "PL", for two reasons: first, as a means of identification, and second, because the letters can be taken to mean "Pitch Lead." The formula given above applies only where the Index Change Gear Ratio is 30 : 1 or 12 : 1. On the Barber-Colman machine with a 15 : 1 ratio

the "PL" means $\frac{\text{N. C. P.}}{\text{Sine Angle X 0.0375.}}$

The best way to explain the use of the formulae is through the use of examples, therefore we will consider that we have a 30 : 1 or 12 : 1 ratio Barber-Colman machine and we are required to find the feed change gears for 19, 63, 26, 56 and 41 teeth, 6 D. P., 23 deg. helix angle. The pinions, with 19 and 26 teeth respectively, are of steel. The 63, 56 and 41-tooth gears are of cast iron. The feed for cutting the steel gears is to be about 0.020 in. per revolution of the work, and for cast iron is to be approximately 0.040 in. per revolution. "PL" in this case

equals $\frac{\text{Nor. Cir. Pitch}}{\text{Sine Angle X 0.075}}$

6 D. P. = 5236 N.C.P.

Sine of 23 deg. = 0.39073.

Substituting in the above formula, we have

$$\text{"PL"} = \frac{0.5236}{0.39073 \times 0.075} = \frac{0.5236}{0.029305}$$

$= 17.867258.$

By separating this number thus: 17 plus 0.867258, our feed gear ratio will be more accurate. Now, from our book of decimal equivalents we select the fraction closest to this decimal. As 13/15 equals 0.8666667, this looks the most promising. Then by adding the first figure we dropped, we have 17 13/15, which equals $\frac{268}{15}$, the value for "PL". 17.867258 divided by 17.8666667 produces 1.00003 error, which is close enough. There really is no error when the same "PL" is used in both right and left hand gears. What actually happens is that the angle of the gears changes just a trifle. An error of 1.00003 as found above equals the helix angle of 23 deg. 0 min. 2/3 sec.; i.e., the angle is off two-thirds of one second, which changes the pitch diameter 0.000003, and this amount is negligible. Also, as the angles of both right and left hand gears will be exactly the same when figured this way, a perfect bearing should result.

For 19 teeth, 6 D.P. with approximately 0.020 in feed, the constant is 67. The Feed Change Gear formula is

$$\text{Feed} = \frac{1 \times \text{"PL"}}{\text{C}}$$

Substituting, we have $\frac{1}{67} \times \frac{268}{15} =$

$$\frac{1}{67} \times \frac{67 \times 4}{15} \times \frac{6}{6} = \frac{\text{ers}}{\text{ens}} \text{ X } \frac{24}{90} = \frac{\text{ers}}{\text{ens}}$$

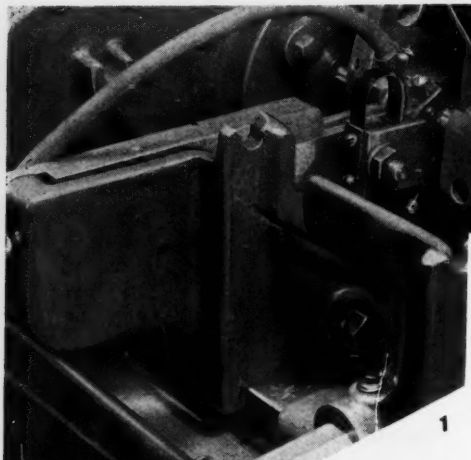
If two 67-tooth gears are not available, use two 60-tooth gears instead, making the feed gears $\frac{60}{60} \times \frac{24}{90} =$

$$\frac{\text{drivers}}{\text{drivens}}$$

Now, if this feed is found to be too slow, it can be changed in from one to two minutes. Let's use a 0.030 feed. The constant for this feed is 43 (taken from the Barber-Colman instruction book). Substituting, we have

$$\frac{1}{43} \times \frac{67 \times 4}{15} \times \frac{6}{6} = \frac{67 \times 24}{43 \times 90} = \frac{\text{ers}}{\text{ens}}$$

The index change gears must also be changed, but as most spiral hobbing machine manufacturers have a list of these in their catalogs, we won't deal with them in this article. Of course every one who has had anything to do with spiral gears knows that the same constant must be used in both index and feed gear formulae.



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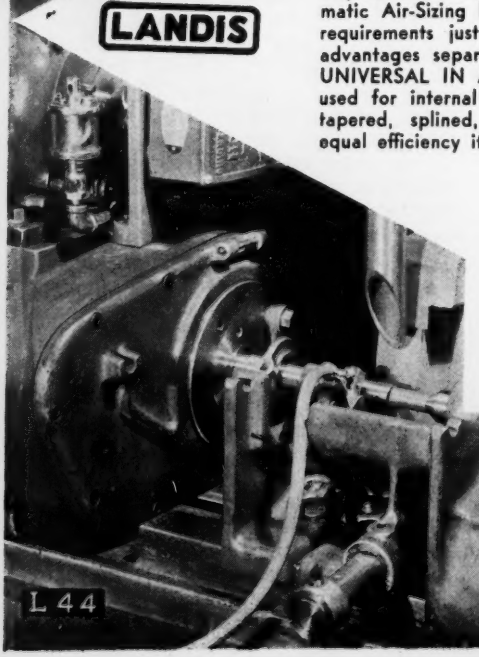

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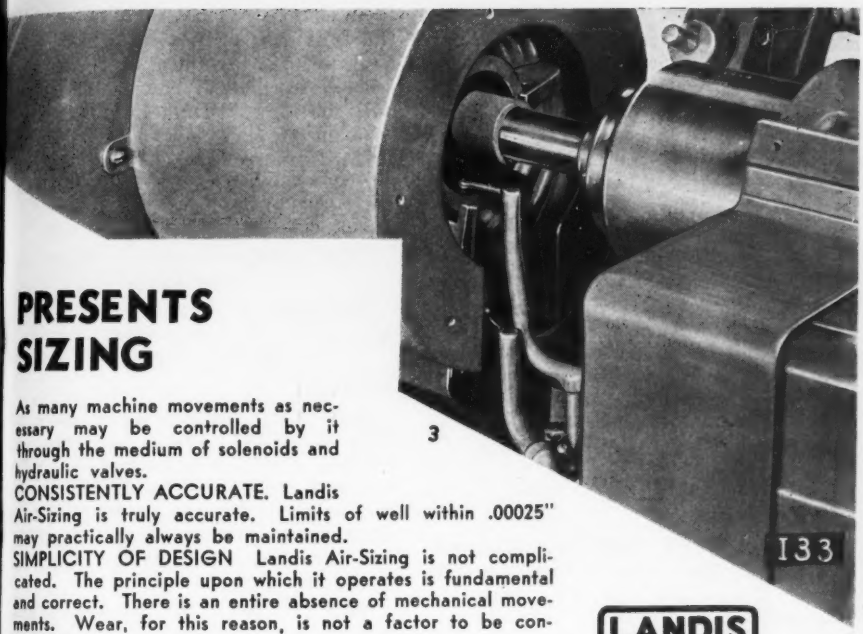

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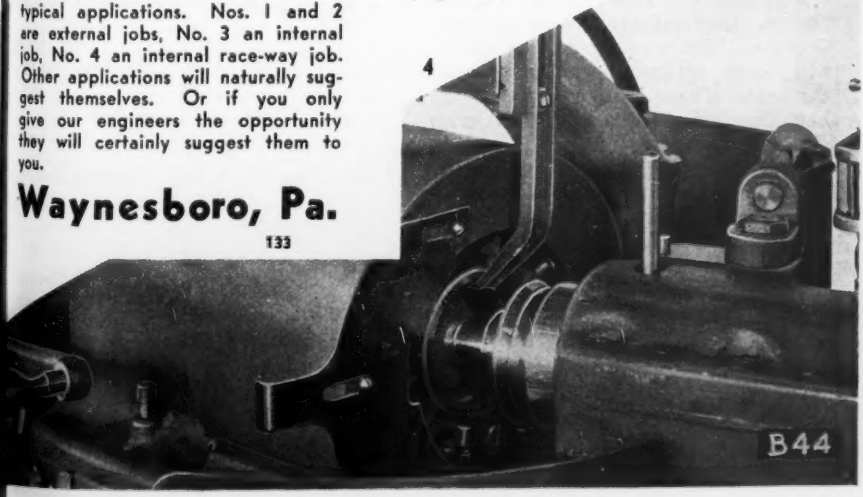

For 63 teeth, 0.040 feed, the constant is 35. Substituting in feed—$\frac{1}{C}$ × "PL", using the same "PL" as before, we have

$$\frac{1}{35} \times \frac{67 \times 4}{15} \times \frac{6}{6} = \frac{67 \times 24}{35 \times 90} = \frac{\text{drivers}}{\text{drivens}}$$

For 26 teeth, 0.020 feed, the constant is 68. Substituting we have

$$\frac{1}{68} \times \frac{67 \times 4}{15} \times \frac{6}{6} = \frac{67 \times 24}{68 \times 90} = \frac{\text{drivers}}{\text{drivens}}$$

For 56 teeth, 0.040 feed, the constant is 33.5. Substituting we have

$$\frac{1}{33.5} \times \frac{67 \times 4}{15} \times \frac{6}{6} = \frac{67 \times 24}{60 \times 45} = \frac{\text{ers}}{\text{ens}} \text{ or } \frac{67 \times 24}{60 \times 45} = \frac{\text{ers}}{\text{ens}}$$

For 41 teeth, 0.040 feed, the constant is 33. Substituting we have

$$\frac{1}{33} \times \frac{67 \times 4}{15} \times \frac{6}{6} = \frac{67 \times 24}{66 \times 45} = \frac{\text{ers}}{\text{ens}}$$

As the "PL" never changes for the same pitch and angle, it can be filed away for future reference, thus saving much time on future set-ups.

Although the following figures apply to other machines than Barber-Colmans, Barber-Colman operators will profit by reading this part of the text. These figures apply to the Lees Bradner and Gould & Eberhardt spiral hobbing machines. The former have 32 : 1 and 24 : 1 ratios, while the G. & E. machines have a 60 : 1 ratio. The feed change gear formula which follows will apply to all three of these ratios.

$$\text{Feed change gears} = \text{"PL"} \times \frac{1}{C}$$

$$\text{In this case "PL"} = \frac{8 \times \text{Nor. Cir. P.}}{\text{sine angle}}$$

As an example, we will consider the following: Required to find the feed changes gears for 21 teeth in the following pitches: 2 1/2, 3, 4, 5, 6, 8, 10, 12. All are to be 23 deg. transversal helical gears. First, we will find the "PL" for 1 D.P.

Transversal Nor. Cir. P. equals Cir. P. × Cosine of angle. Substituting, N.C.P. equals 3.1416 × 0.9205 = 2.8918428.

$$\text{"PL" equals} \frac{\text{N.C.P.} \times 8}{\text{Sine Angle}}. \text{ Substituting,} \frac{2.8918428 \times 8}{0.39073} = \frac{23.134742}{0.39073} =$$

59.209024.

Separating 59.209024, we have 59 plus 0.209024. From our book of decimal equivalents we find that 4/19 equals 0.210526 and by adding the 59 we dropped, it gives us 59 plus 4/19 = 1121/19 = "PL". To find the "PL" for any pitch, multiply the "PL" for 1 D.P. by 1/D.P.

Then "PL" for 2 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/2 = \frac{1125}{38}$

Then "PL" for 2½ D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 2/5 = \frac{450}{19}$

Then "PL" for 3 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/3 = \frac{375}{19}$

Then "PL" for 4 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/4 = \frac{1125}{76}$

Then "PL" for 5 D.P. 32 deg. Transversal equals $\frac{1125}{19} \times 1/5 = \frac{225}{19}$

Then "PL" for 6 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/6 = \frac{375}{38}$

Then "PL" for 8 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/8 = \frac{1125}{52}$

Then "PL" for 10 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/10 = \frac{225}{38}$

Then "PL" for 12 D.P. 23 deg. Transversal equals $\frac{1125}{19} \times 1/12 = \frac{375}{76}$

For 21 teeth, 2½ D.P., 0.020 feed; C is 150. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{150} \times \frac{450}{19} =$$

$$\frac{36}{76} \times \frac{25}{75} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 3 D.P., 0.020 feed; C is 134. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{134} \times \frac{375}{19} =$$

$$\frac{30}{76} \times \frac{25}{67} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 4 D.P., 0.020 feed; C is 115. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{115} \times \frac{1125}{76} =$$

$$\frac{27}{76} \times \frac{25}{69} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 5 D.P., 0.020 feed; C is 87. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{87} \times \frac{225}{19} =$$

$$\frac{36}{76} \times \frac{25}{87} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 6 D.P., 0.020 feed; C is 67. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{67} \times \frac{375}{38} =$$

$$\frac{30}{76} \times \frac{25}{67} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 8 D.P., 0.020 feed; C is 49.5. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{49.5} \times \frac{1125}{152} =$$

$$\frac{30}{76} \times \frac{25}{66} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 10 D.P., 0.020 feed; C is 41. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{41} \times \frac{225}{38} =$$

$$\frac{36}{76} \times \frac{25}{82} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 12 D.P., 0.020 feed; C is 34. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{34} \times \frac{375}{76} =$$

$$\frac{30}{76} \times \frac{25}{68} = \frac{\text{ers}}{\text{ens}}$$

For 21 teeth, 16 D.P., 0.020 feed; C is 21. Substituting in

$$\text{Feed} = \frac{1}{C} \times \text{"PL"}. \quad \frac{1}{21} \times \frac{1125}{304} =$$

$$\frac{45}{76} \times \frac{25}{84} = \frac{\text{ers}}{\text{ens}}$$

The "PL" for 45 deg. Transversal gears of 1 D.P. is found in the same way. 1 D.P. "PL" is $\frac{13}{P} \times \frac{29}{15}$. Then the "PL" for any other pitch is found by $\frac{1}{\text{DP}} \times \frac{13}{1} \times \frac{29}{15}$. Example for 8 D.P. is $\frac{1}{8} \times \frac{13}{1} \times \frac{29}{15}$ is $\frac{13}{8} \times \frac{29}{15}$

Then the feed change gear formula

will be $\frac{1}{C} \times \frac{13}{8} \times \frac{29}{15}$. The "PL" for 45 deg. helical gears of 1 D.P. is $\frac{14}{1} \times \frac{33}{13}$. Then the feed change gears for other pitch gears of 45 deg. angle are found by the formula

$$\frac{14}{C} \times \frac{33}{13} \times \frac{1}{DP} = \frac{ers}{ens}$$

The "PL" for 25 deg. 47 min. of 1 DP is $\frac{520}{9}$; then the feed change gears for 6 D.P. would be

$$\frac{1}{D.P.} \times \frac{1}{C} \times \frac{520}{9} = \frac{520}{C \times 6 \times 9} = \frac{260}{C \times 27} = \frac{ers}{ens}.$$

The "PL" for 21 deg. 47 min. of 1 DP is $\frac{65 \times 25}{24}$; then the feed change gears for 8 D.P. would be

$$\frac{1 \times 1 \times 65 \times 25}{DP \times C \times 24} = \frac{65 \times 25}{C \times 8 \times 24} = \frac{ers}{ens}$$

The above is given to aid the reader in familiarizing himself with the method of obtaining the "PL". These formulas have been used constantly over a period of years, and are correct. If a trial cut appears questionable, the error, if any, will be found in the set-up.

The following is included as an aid in finding constants for calculating set-ups for large-pitch teeth. Let 195 be the constant used in cutting the pinion. Then if the gear is to have 84 teeth we have (195 × 84)—1= 16,349 divided by 11 equals 1,489, which is a Prime Number. Add either ½ or 1/4 or 1/5 of the number of teeth to the answer above, thus: 1489 plus 42 equals 1531 Prime Number, plus 42 equals 1573 Prime Number, plus 42 equals 1615 Prime Number, which is correct. Multiplying by the 11 used as a divisor above we have (1615 × 11) plus 1=17,766. Divided by 84 (No. of teeth), we have our constant which is 211.5. Proof: (211.5 × 84)—1=17,765 with factors of 5×11×17×19.

"Tumbling, Rolling, and Barrel Burnishing"

Under the above title the Magnus Chemical Co., Garwood, N. J., has issued a 48-page book in which, in technical article form, subjects relating to the cleaning, drying, polishing, and burnishing of metal parts are discussed.

The articles are entitled "Tumbling, Rolling and Barrel Burnishing"; "Barrel Rolling Operations"; and "Barrel Burnishing". In the first article the several operations are defined and explained, and full directions are included as to the manner in which the operations are performed. The article discusses in detail the different kinds of work that can be cleaned or finished by the use of the barrel, the kind of barrel used, and the effects obtained by the use of liquids, balls, abrasives, or chemicals. Both photographs and drawings are used to illustrate the points made in the article.

The second article is devoted largely to descriptions of the various types and kinds of barrels and barrel-rolling machines, with additional information regarding abrasives, chemicals and the cases in which they should be used. This article also gives figures as to production with comparisons for estimating costs.

The third article covers the ground from a different angle, giving the history of barrel burnishing and explaining the theories upon which the operations and use of the equipment are based. Formulas for burnishing compounds are given and descriptions of equipment used in connection with barrel burnishing are included. Altogether, the book will serve as a valuable manual in any plant where the cleaning, polishing, or burnishing of small parts is a problem. A copy is available to any mechanical executive who will address his request on his firm letterhead.

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PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

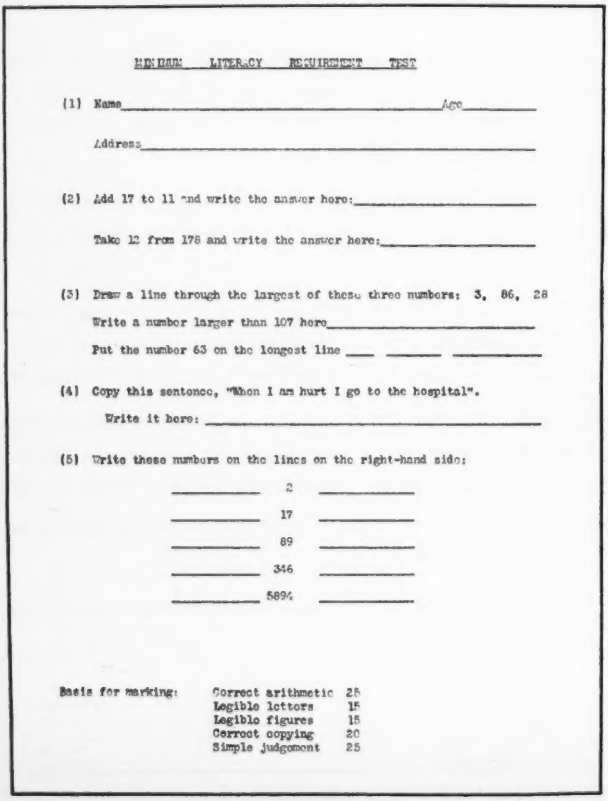
Tests Indicate Fitness of Applicants for Jobs

By W. I. Newman
Employment Manager, Consolidated Ashcroft Hancock Company

As told to Francis A. Westbrook

IT IS obvious that if a misfit applicant for a job can be eliminated in the employment office, instead of after the foreman has given him up as hopeless perhaps three or four weeks later, it will mean that at least the three or four weeks' pay will have been saved and possibly a good deal of spoiled material, to say nothing of damage to machinery and tools. With this end in view, the Consolidated Ashcroft Hancock Company, Bridgeport, Conn., has devised a series of tests that are used by the employment department in determining the fitness of applicants for specific jobs.

These tests have more than justified their use not only by actual savings in dollars and cents, but also in the saving in time that would otherwise be wasted. For instance, in the past the only sure way



MINIMUM LITERACY REQUIREMENT TEST

(1) Name_____ Age_____

Address_____

(2) Add 17 to 11 and write the answer here:_____

Take 12 from 178 and write the answer here:_____

(3) Draw a line through the largest of these three numbers: 3, 86, 28

Write a number larger than 107 here_____

Put the number 63 on the longest line ____ _____ _____

(4) Copy this sentence, "When I am hurt I go to the hospital".

Write it here: _____

(5) Write these numbers on the lines on the right-hand side:

_____	2	_____
_____	17	_____
_____	89	_____
_____	346	_____
_____	5894	_____

Basis for marking:		
	Correct arithmetic	25
	Legible letters	15
	Legible figures	15
	Correct copying	20
	Simple judgement	25

Fig. 1 — The Minimum Literacy Test. Even employees on the most menial jobs should have enough education to be able to read signs and orders and to understand instructions.

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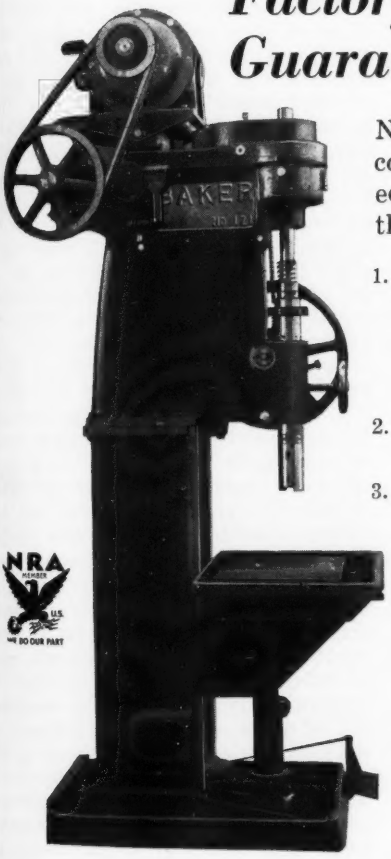

Now is the opportune time to consider your drilling costs and equipment. Give a moment's thought to the following:

1. You are using the best high speed twist drills. Will your present machines drive them at the speeds and feeds they will stand? Have your machines the necessary rigidity and power?

2. Are your upkeep costs on your present machines excessive?

3. Have you considered the possibilities of modern box column heavy duty drills on your work, which you may now be doing on other type machines?

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TOLEDO, OHIO, U. S. A.

to find out whether or not an applicant was telling the truth when he stated that he was an experienced lathe hand was to put him at a lathe in the shop and try him out. If he was bluffing, very likely he damaged the machine and possibly injured himself. If the fact can be determined in the employment office, without bothering the factory, then both time and expense have been saved. As a matter of fact, the most of these tests have been found by experience to be approximately 85 per cent successful, which is about as good an average as could be expected.

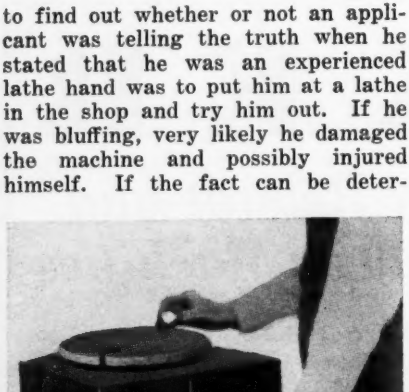


Fig. 2—Test to determine machine operating ability. To drop the ball through the hole in the disc at the right instant requires coordination of mind and muscle.

These very interesting results have been obtained by means of extremely simple and practical tests which resemble closely the tasks for which the applicants are being tested. The object of each test is to find out what an applicant for a job knows; not what he is capable of learning. The latter type of tests, known as aptitude tests are, of course, given in many cases, especially when selections are being made for an apprenticeship course. Under such circumstances the applicant is not expected to know anything about the subject; the main idea of the test is to discover whether or not he is capable of learning. It naturally follows that such a test is difficult to apply, and usually calls for the service of a trained psychologist.

While the aptitude test has proven of great value in many instances, the expense of providing the right facilities for properly giving such tests usually restricts their use to the larger companies only. On the other hand, machine shops of average size are more given to employing men for specific jobs from time to time as the need arises than they are to training young men with the idea that such men will continue as a part of their organizations indefinitely. For this reason this article will be confined to a discussion of the tests used by the Consolidated Ashcroft Hancock Company in determining an applicant's existing knowledge or acquired ability. The tests may be compared, roughly, to a college entrance examination, for they are intended to show how much the applicant has learned and his fitness for the work that is to be done.

In the course of many years of experience in the making of tests this company has developed a large number of tests of various kinds, each of which is especially applicable to certain kinds of work. The complete set of tests will cover all kinds of manual or clerical work found in the plant, but those discussed here will be confined to machine shop work only. The tests under discussion have been checked many times by trying them on machinists who are known by practical experience to be good mechanics, and these men always pass the tests with credit. Experience has also shown that—as already stated—85 per cent of the applicants who pass these tests make

satisfactory employees insofar as their skill is concerned, so there can be but little doubt as to their effectiveness. Such tests are productive of a much better idea of the capabilities of an employee than can possibly be gained through an interview.

There are a few things that all competent mechanics must be able to do. They must be able to read and write, and solve simple arithmetic problems. They must be able to discern between good and bad work, especially if the job is to involve any inspection or supervision. They must be able to operate certain standard machines such as lathes, profilers, and milling machines, and they must be able to read micrometers and blueprints. To discover the ability of an applicant along the lines indicated, six tests are used. The tests have been worked out to such a point that the person who gives the tests does not have to be a machinist himself in order to know how well or how badly the applicant has done. Furthermore, the tests closely approximate working conditions; thus they are both reasonable and of practical value.

In this discussion let us start with the minimum literacy test, which is used to find out whether the applicant is able to read and write simple English, as well as understand it. It also tells whether the applicant knows enough arithmetic to be able to tell whether he is receiving the correct amount of pay. This test probably is unnecessary for machinists, for such a slight degree of literacy would be indicated by the other tests, but it is always necessary to have a certain number of employees around a plant to do the work for which a minimum of intelligence and education is required, such as sweeping, trucking and so on. It is highly desirable that even employees on such jobs should be able to read signs and understand instructions. It is impossible to run any plant, however small, according to any planned scheme of management if the men in even the most unskilled jobs do not have at least a rudimentary knowledge of the three R's.

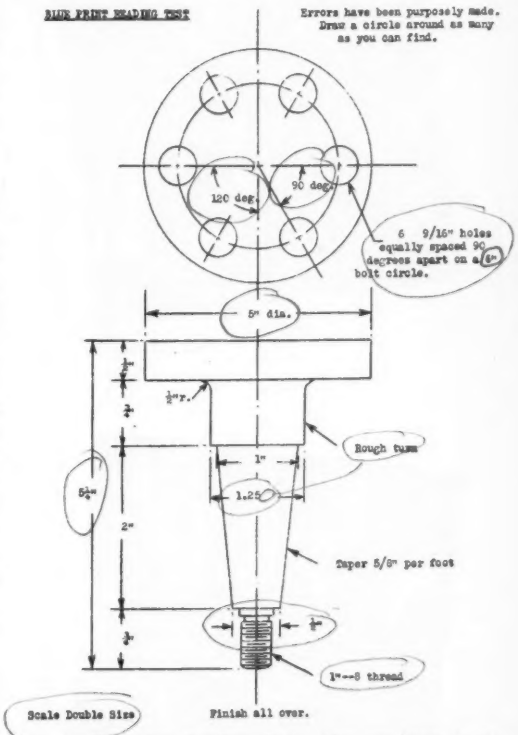
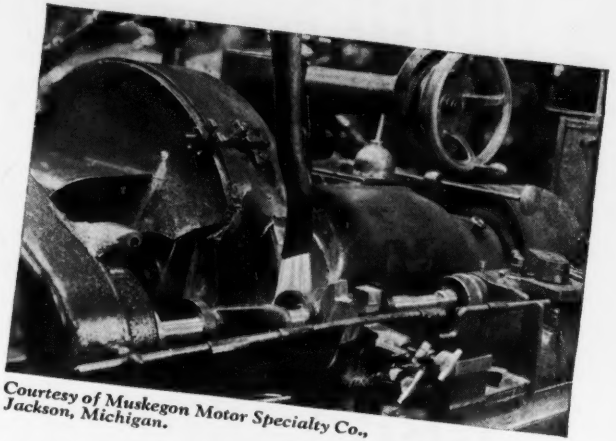


Fig. 3—Blueprint Reading Test. The applicant is required to circle the errors on this drawing and explain why the dimensions circled are incorrect.

Courtesy of Muskegon Motor Specialty Co., Jackson, Michigan.

OPERATION: SURFACE AND STRADDLE MILLING, CRANKSHAFT COUNTERWEIGHT PADS.
MACHINE: DEVLIEG NO. 30 SUPERMIL.
MATERIAL: 1045 STEEL.
STOCK REMOVAL: 3/16 INCH PER PAD.
PRODUCTION: 17 PER HOUR.
LUBRICANT: 1 PART SUNOCO TO 30 PARTS WATER.



Courtesy of Muskegon Motor Specialty Co., Jackson, Michigan.

OPERATION: FINISH GRIND CRANKSHAFT CENTER MAIN BEARING—PLUNGER CUT.
MACHINE: LANDIS GRINDER.
MATERIAL: H. R. TYPE "EE" STEEL.
SPINDLE SPEED: 750 R.P.M.
WHEEL SIZE: 2.188 INCH FACE, 30 INCH DIAMETER.
STOCK REMOVAL: 25 THOUSANDTHS OF AN INCH.
PRODUCTION: 40 PER HOUR.
COOLANT: 1 PART SUNOCO TO 60 PARTS WATER.

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with *LOWER* operating costs

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tool re-sharpening is decreased, deeper and faster cuts are made possible, work is kept cooler, production increased

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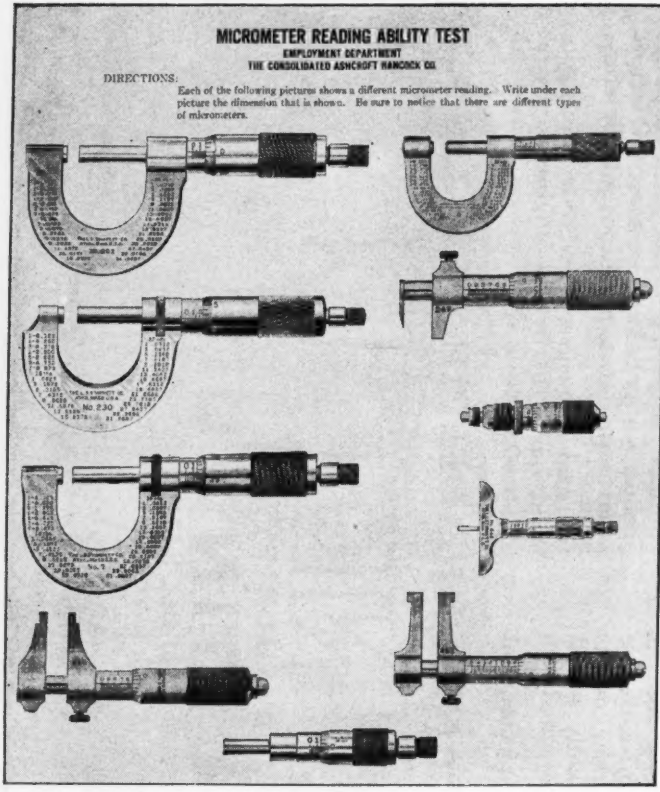
MICROMETER READING ABILITY TEST
EMPLOYMENT DEPARTMENT
THE CONSOLIDATED ASHCROFT HANCOCK CO.
DIRECTIONS:
Each of the following pictures shows a different micrometer reading. Write under each picture the dimension that is shown. Be sure to notice that there are different types of micrometers.

Fig. 4—Applicants for jobs as skilled mechanics are required to read the settings of these micrometers and write the dimensions indicated on a sheet of paper.

The minimum literacy test, which consists simply of a sheet bearing a number of questions that have to be answered, is shown in Fig. 1. Although it is so elementary that it seems as though almost anyone would be able to pass the test, experience has proved that many of the applicants for jobs are unable to do so.

The machine operating ability test is for the purpose of finding out whether or not the applicant can quickly adapt himself to an operation to which he is not accustomed. An experienced machinist will, of course, be able to do so, but probably not if he has worked all his life at one kind of machine. Job shops or plants in which a great number of different products are made, such as our own, naturally have a large and varied assortment of operations, included among which will be a large number of special set-ups that have been developed especially for the requirements of the plant. For this reason it may be desirable or even essential to include in the manufacturing organization a number of men of sufficient ability to handle operations with which they could hardly be expected to have become familiar.

The test itself is extremely simple, and is made with a machine which is about as lacking in complication as anything could well be. The machine shown in Fig. 2 consists of a revolving disc very much like that of a small phonograph. This disc has a hole in it which passes—at each revolution of the disc—over the opening in the large end of a funnel. The applicant is asked to drop a number of balls through the hole at the mo-

ment it passes over the funnel. He is told to pick up each ball with his left hand, pass it to his right hand, and then drop it in the hole at the correct instant. The balls properly dropped are counted automatically. Simple as this test appears, experience has shown that it is certainly effective in eliminating applicants who are too awkward to become good operators of machines with which they are not accustomed. In other words, it has been found to be a good way to reduce the expense of selecting workers who can quickly adapt themselves to work which is new to them.

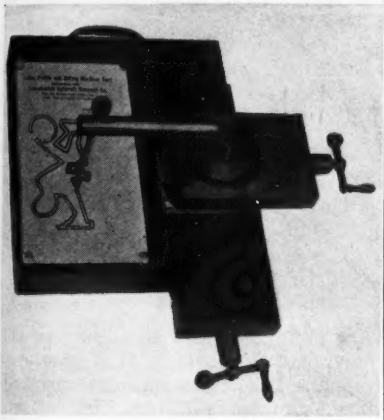

Fig. 5—(Above) An experienced lathe hand or toolmaker will be able to manipulate the handles so as to make the marking point follow the course laid by the double line on the chart. (Right) Reproduction of the chart.

The blueprint reading test is just about as simple and obvious. It goes without saying that no so-called machinist who cannot read a blueprint will make a satisfactory worker in a modern machine shop. Each applicant is given a test drawing showing the dimensions of a very simple piece of work. There are a number of errors on the drawing, which the applicant is requested to discover and indicate by drawing circles around them. One of the drawings is shown in Fig. 3. An explanation is also required as to why the applicant considers the circled parts or dimensions incorrect. No time limit is set, and the ability to finish the test with no more than three errors on the part of the applicant is considered to show passing ability. This test also has proved its worth over a long period of time and in the course of hundreds of trials.

It is very essential that skilled machinists be able to read any one of a variety of micrometers; therefore, the applicant for a job as skilled machinist is given a copy of the sheet shown in Fig. 4. This sheet shows illustrations of ten different kinds of micrometers, the settings of which are all different. He is asked to write the readings on a sheet of paper, and the examiner then compares the readings with the correct readings as noted on a transparent

stencil. It is not actually necessary that the examiner be able to read the micrometers himself. The ordinary machinist is not required to be able to read more than the simple standard micrometers, and failure to be able to read the more complicated types is not held against the applicant. A highly skilled toolmaker or diesinker, however, should be able to read all of them. It should be observed that there are no errors in the micrometer settings, and no attempt is made to fool the applicant. In fact, nothing of this kind is ever done, as experience has shown that nothing is gained by such methods.

Another test that can as easily be applied as the others and which has given very good practical results is the test to determine the ability of an applicant to operate a lathe, milling machine, or profiler, as well as other similar machines. Experience with this device has shown that unless an applicant has had actual experience in operating a lathe he cannot possibly pass the test, and it has the advantage of corresponding so closely to the actual mechanism of a lathe that the average shop worker, as well as the foreman or superintendent, readily appreciates its value and fairness.

The apparatus with which this test is made is shown in Fig. 5. It consists of the cross slide of an ordinary lathe, mounted on a wood base and having an extension arm provided with a marking point similar to that on a recording meter. The paper chart with a complicated double line, shown in Fig. 5, is placed under the marking point and the applicant is asked to move the point, by means of the handles, so as to follow the course laid between the lines on the chart. It is obvious that this corresponds exactly to the movement required in manipulating the cutting point of a lathe tool, and unless the operator has had some experience he cannot keep the point between the lines without moving very slowly. The ink mark is a record which, of course, cannot be disputed.

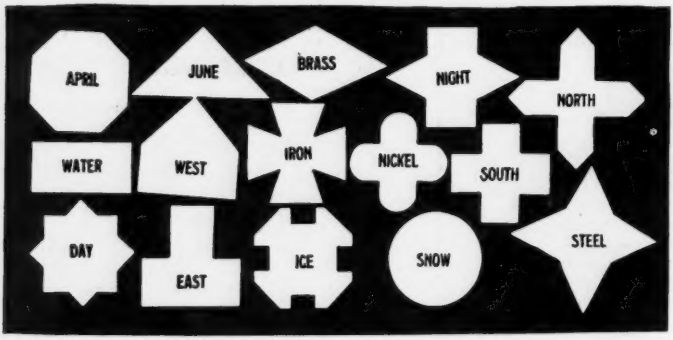

Fig. 6—The applicant is given three minutes to study this chart, then he is required to write the words in the blank forms on the large sheet shown in Fig. 7.

The final test determined upon as of value in the selection of applicants for mechanical work is known as the observation test. This test is intended to indicate the ability of a man to make accurate observations and is of particular value where the element of inspection or a critical attitude toward a man's own work comes in. In this test the applicant is given a sheet bearing a number of drawn forms of various shapes, each form being labeled with a word apparently selected at random. The form used is shown in Fig. 6.

The applicant is allowed three min-

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Rochester, N. Y., U. S. A.

Division of Consolidated Machine Tool Corporation of America

utes in which to study the sheet, then he is given a similar sheet upon which the forms have been arranged in different order and the words omitted, and he is requested to write into each form the word which identified it on the original sheet. Experience has demonstrated that when an applicant can complete this test with no more than two mistakes, his powers of observation are first class and he should make a satisfactory inspector insofar as his ability along this line is concerned. However, it has also been found that the ability to complete this test satisfactorily varies greatly even among men of higher education; thus ability in this respect is not dependent upon education.

The tests that have been described here have, as repeatedly mentioned, been the result of a great deal of experience and have proved their value by the results obtained. The development of a new test to determine some desired characteristic or ability is usually a long and arduous task in which much experimenting and many disappointments are involved. Success in the formulation of such tests calls for a good grounding in psychology and the use of statistics, and it can hardly be hoped that the amateur at this sort of work can be of much help to himself in devising new tests.

However, by confining activities in this direction to the use of tests that have been tried out by a number of firms over a wide field, such as those described in the foregoing article, the employer of mechanics and other help for a metal working plant should be able to greatly simplify the problem of selecting competent help.

In conclusion, it may be said that the tests can all be quickly applied by a person who is neither a machinist nor a psychologist. The fact that each test bears a certain amount of resemblance to the work for which the applicant is being examined gives it the element of practicality. Furthermore, the tests tell a great deal that cannot be brought out in an interview, and they take much less time. At the same time, it must be

(Continued on page 41)

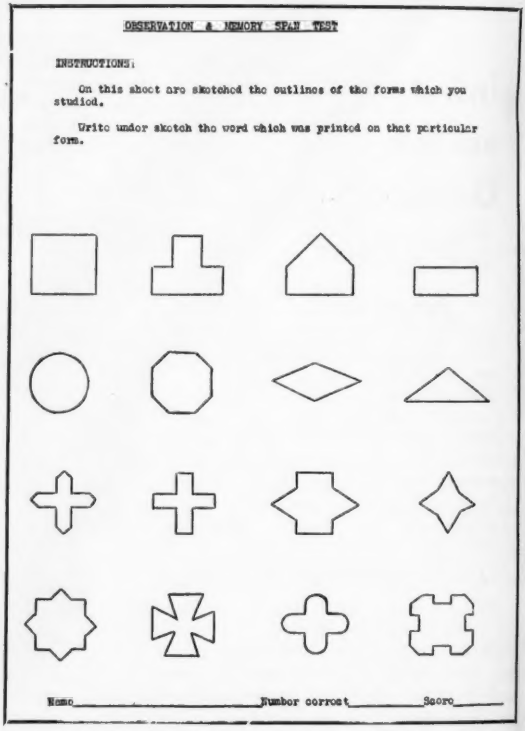
OBSERVATION & MEMORY SPAN TEST
INSTRUCTIONS:
On this sheet are sketched the outlines of the forms which you studied.
Write under sketch the word which was printed on that particular form.
Name
Number correct
Score

Fig. 7—Sheet used in observation and memory test.

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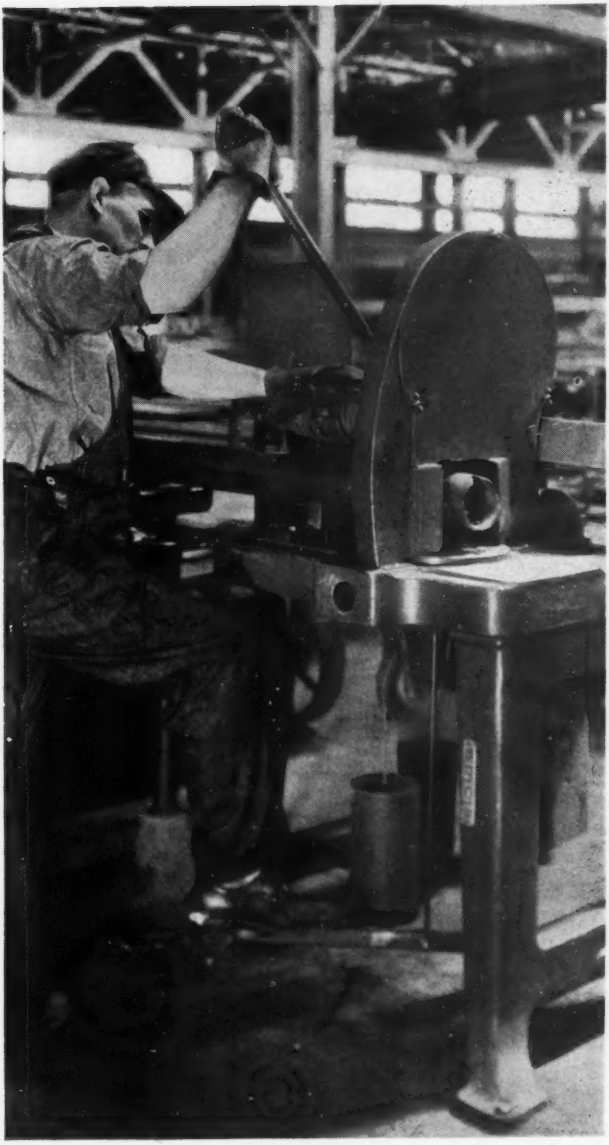


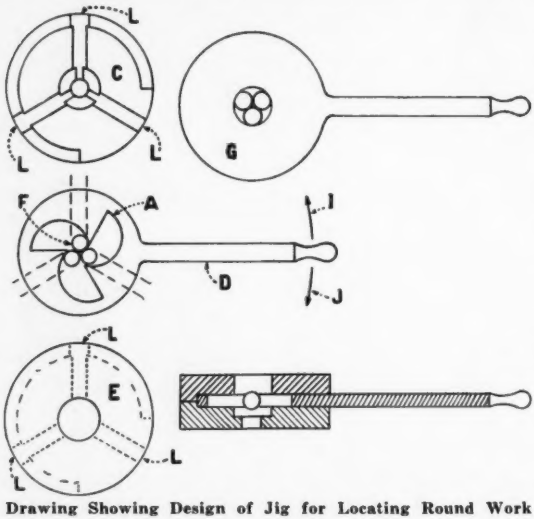
els; Abrasives for Polishing; Abrasive Bricks and Sticks; India Oilstones; d Tubes—Non-slip Tiles, Treads and Aggregates. « « « « « « «

IDEAS FROM READERS

Jig for Centrally Locating Round Work

By John E. Hyler

THE drawing shows the design of a jig in which bushings or other cylindrical pieces may be located centrally while in process of being clamped. The chief advantage of the jig lies in that it will handle work of various diameters without any changes being made in any part of it, and will locate all pieces accurately in the center.

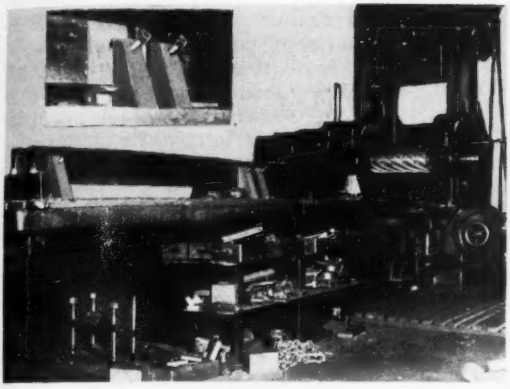


Drawing Showing Design of Jig for Locating Round Work

The two pieces C and E are recessed to receive the levered cam D, half the thickness of D being taken from each of the parts as indicated and a portion of the resulting flange being cut away to allow free movement of the cam handle. The two pieces are then drilled for bolts and are securely bolted together without the cam between. The three holes L are then drilled radially as shown, exactly on the line of the joint and 120 deg. apart, and are reamed to receive the steel balls F with an easy working fit.

In the drawing of the cam, at D, the position of the three holes which are to serve as channels for the balls are indicated by broken lines, and the cam is shown as having been moved to the limit in the direction of the arrow I, in which position the three balls are tightened together. The layout of the opening A in the cam is based on three semicircles at 120 degrees apart with respect to their base lines. It will be seen that as the lever is pulled in the direction of the arrow J, the balls will be allowed to move farther back into their channels L, and when the lever is again moved toward I, the balls will be forced inward. The balls are positively moved an equal amount and in the process of moving inward they centralize and clamp the work that has been placed in the center of the jig.

The assembled plan view at G shows that the top opening is left just small enough so that none of the balls can get out of the jig unless the jig is disassembled by removing the bolts which hold the pieces C and E together. If desired,



Locomotive Crosshead Guides Set Up In Fixtures for Milling. (Inset)—Close View of Fixtures

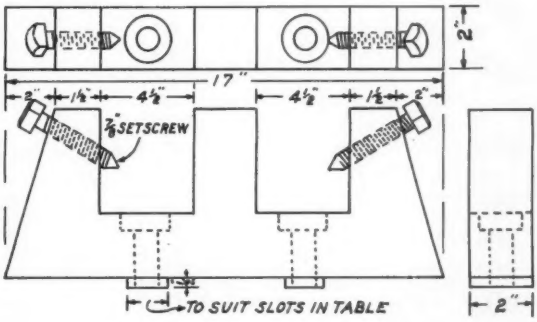
a segmental ratchet can be arranged to hole the lever of the cam D in "tight" position, or an extension spring of suitable length can be made to perform the same duty. There are many instances where this principle of self-centering, three-point clamping will be found very convenient.

Fixture for Milling Locomotive Crosshead Guides

By H. H. Henson

THE illustrations herewith show how locomotive crosshead guides can be milled in a planer-type milling machine, using fixtures which locate and hold the guides in the proper position for milling. A set consists of two fixtures—one for each end of the guides—each fixture consisting of a block in which slots have been milled of sufficient size to hold the guide. Each block has two slots, thus making it possible to mill a pair of guides at a setting, and if two sets of fixtures are used as shown in the illustration, four guides can be milled in one operation.

Counterbored holes are provided in the bottoms of the slots so that the fixtures can be bolted to the table of the machine in the usual manner. Pointed setscrews, set into the fixtures at an angle, as shown in the drawing, provide means for locking the guides firmly in position. The fixtures are very simple to make, and will save enough time to more than than repay their cost many times over.



Drawing of Fixtures for Milling Guides

Cutting a Drum Cam in the Lathe

By Charles Kugler

IN THE process of making parts for a special machine that was to be built in our shop, we were required to make a drum cam of a de-

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No. 3 Automatic Tapping Unit. 3" stroke. 1, 2, 3 H. P.

No. 2 Millholland Automatic Drilling Unit —2½" stroke—⅓, ½, ¾ H.P. Motor Drive.
No. 3 Unit—3" stroke, 1, 2, 3 H. P.
No. 4 Unit—4" stroke, 1, 2, 3 H. P.
No. 5 Unit—5" stroke, 5 H. P.
No. 6 Unit—8" stroke, 15 H. P.
Milling Heads attachable to any of these units.

sign similar to that shown at A in the drawing. Having no machine of the cam-cutting variety, we had decided to send the job out when it was suggested that the job might be handled in a lathe. By setting up the lathe as shown, we produced a

Drawing showing how a lathe was set up to machine a drum cam.

satisfactory job—and without spending one cent for special tools.

The cam was to be made three inches in diameter and two inches long, with a ⅜-inch rise. In setting up the lathe for the job, we geared it so that the carriage would travel two inches for one revolution of the work, or ½ thread per inch. The taper attachment was then set over so that the tool would move in; that is, in a transverse direction, ⅜ inch for each two inches of carriage travel or 3/16 inch per inch of travel. Before putting the cam into the lathe, a slot was milled in the cam ⅜ inch deep and ⅛ inch wide for tool clearance.

In operation, the cam was cut in about the same manner as a thread

is cut; that is, the lathe was reversed after each cut and the handle (C) was moved in slightly. The depth of the cut was obtained by tapping the tool B, and the tool travel was obtained by moving the handle C. By using this method, we produced an accurate job at a cost 30 per cent less than the price quoted us by a shop operator who possessed a cam-cutting machine.

Cutting V-Belt Grooves in a Milling Machine

By Frank W. Curtis

USUALLY the first thought that comes up when a cylindrical piece is to be machined is "what lathe is available?" Seldom is the milling machine considered, but it is surprising to know how many cylindrical parts can be finished effectively in a milling machine, sometimes even faster than in a lathe.

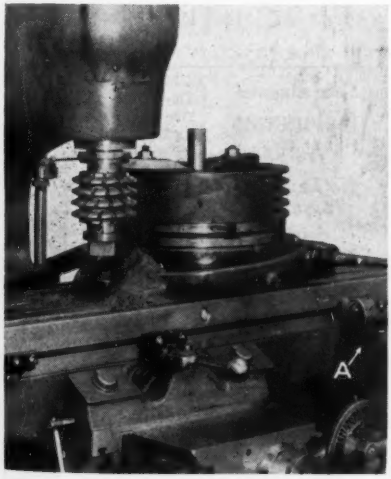
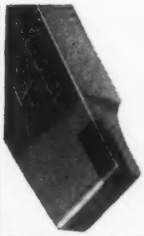


Fig. 1—Vertical Milling Machine Set Up to Mill V-Belt Grooves in a Cast Iron Sheave.

An excellent example of this kind is illustrated in Fig. 1, which shows



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Reduction in Scrap! Decreased Tool Costs! These are just two of the many ways in which Carboloy tools cut machine shop costs and add to your profit margin. These savings alone often justify the use of cemented carbide on many varied types of jobs. For instance, on one job in a well-known plant (name on request), Carboloy tools reduced the scrap 95 per cent, making a saving which, according to the Factory Manager, "will pay for the Carboloy tools on this job for years to come!" In another shop, a *single* Carboloy tool saved $312.00 in grinding wheel cost by successfully turning 50 chilled iron rolls previously non-machineable.

These are not unusual cases. They are but two of many typical examples of Carboloy tool savings on production and job-lot work. Investigate the possible economies in your shop also, through the use of Carboloy tools. Start towards lower machine shop costs and increased profits by sending for the booklet shown below. No obligation.

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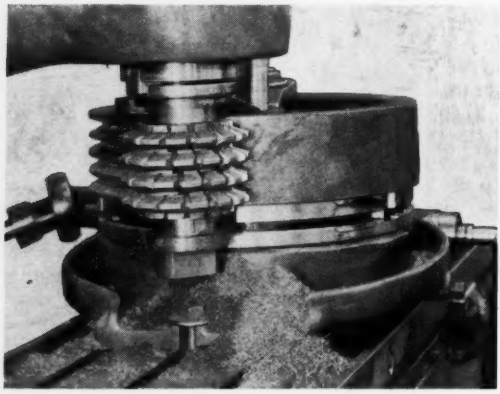

Fig. 2—Close-Up View Showing Cutter Engaged in Work

a setup for milling V-belt slots in a cast iron sheave. The operation is performed in a vertical milling machine, using a standard rotary table of the power driven type. The sheave shown has four slots so that four formed cutters are used. In Fig. 2 is shown a close-up view of the operation, which is handled as follows:

After a workpiece has been loaded and clamped, the feed to the rotary table is engaged. The operator then feeds the machine table longitudinally by hand so that the cutters enter the sheave to the proper depth. A stop is provided on the machine table to enable the depth to be controlled accurately. This is shown at A in Fig. 1. After the machine table has been locked, the rotary table is allowed to make one complete turn after which the machine table is unlocked and brought back to the loading position, where the sheave is removed.

The finish produced by milling grooves of this kind is unusually

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Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 in.	30 in.	2,000
60 in.	30 in.	2,000
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smooth and accurate, as well as concentric. However, there will be very slight cutter marks running crosswise in the grooves which give the advantage of increasing the friction of the driven belt so that slipping is reduced to a minimum. With a turned groove, the cutter marks are annular with the result that they do not offer the same friction that is gained by the milled finish.

With a milling machine in good condition and of suitable size, it will be possible to mill sheaves of this type in one cut and very often to complete the cut in less time than is required when a lathe is used.

Multiple Drilling on Close Centers

By Emil Gerhardt

A PART for an electrical device that we were called upon to make consisted of a square section of ⅛-in. fiber in which four No. 65 holes were required to be drilled on a ½-in. circle with a fifth hole in the center, as shown in the drawing. As the quantity was large, it was imperative that the job be done with a multiple drilling head, if possible but it was found that it was impossible to set the spindles in the multiple head close enough together to drill the holes to the required dimensions. The problem was solved, however, in the following manner.

The five drills that were to be used were soldered to the ends of sections of piano wire, the five lengths of wire being even. The piano wire extensions were then attached to the spindles in the multiple head by means of collars and setscrews, as shown. A trial showed that, although the idea was a success, running the spindles at high speeds caused the wire extensions to

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Chicago Wheel & Mfg. Co.
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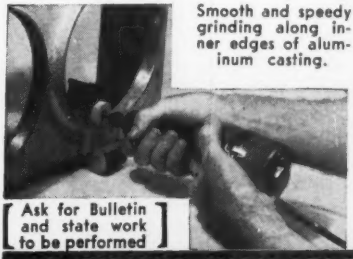

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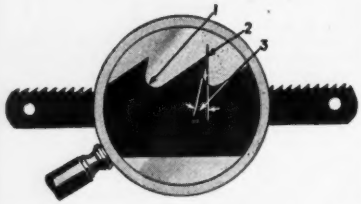

The "Whale Brand" Hack Saw Blades feature an Undercut Tooth which assures faster cutting, longer life and less breakage. Here is why:

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2 Keen, sharp edge insures long life.

3 Undercut tooth requires less pressure per stroke. Less number of strokes to cut piece.

The Undercut Tooth is manufactured under a patented process.
Modern machinery and proven methods make certain that each and every Whale Blade is uniform in quality.

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Try this blade in your own shop. We will gladly send a sample blade to department heads and executives writing on their company stationery. See for yourself how the undercut tooth saves time and increases the life of the blade.

"Whale Brand"

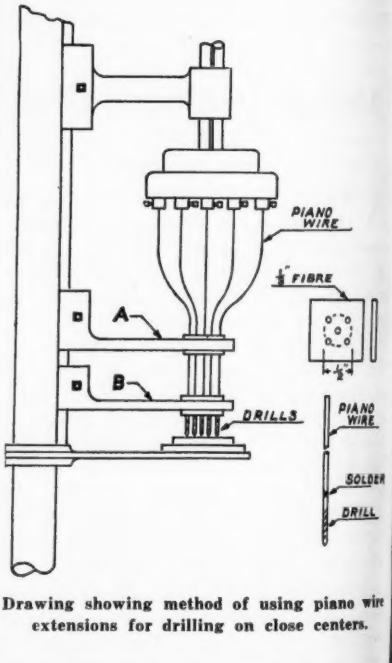
The Hacksaw Blade with the undercut tooth.

The FORSBERG MFG. Co.

BRIDGEPORT, CONN.

bulge out; that is, the centrifugal force apparently forced the wires to form loops, with the result that the drills were prevented from functioning and trouble was experienced from the wires breaking off. This difficulty was remedied by making and attaching the bracket A, in addition to the bracket B which served to locate the drills at the proper distances. The bracket A could be set at the correct height to eliminate trouble.

The fact that the material was soft and the speed of the drills was high



Drawing showing method of using piano wire extensions for drilling on close centers.

overcame the tendency of the wires to bend when the drills came in contact with the work. This method is now used in the drilling of many jobs that otherwise would be impossible due to the small space between the holes.

Ryerson Publishes New Steel Book

Joseph T. Ryerson & Son, Inc., 17th and Rockwell St., Chicago, Ill., has published a book which contains, in addition to a complete listing of all the various products made and marketed by the Ryerson organization, a considerable amount of information which should be of interest to designing engineers and buyers of materials and equipment.

This firm not only handles all kinds of steels in sheets, bar stocks, and tubes, but also special shapes such as flanges, manhole covers, boiler hangers, and so on. Bolts, nuts, screws, chain, woven wire, and similar products are also carried. The equipment marketed by this firm includes electric drills, chain hoists, sheet metal machinery of all kinds, and machine tools, all of which are listed and illustrated in this book.

The engineering information includes a number of valuable tables for engineers, such as the physical properties of various steel, S. A. E. Standard Specifications, safe loads for steel floor plates and corrugated sheets, and so on.

Copies of this book are available to any plant executive who will address his request on his firm letter-head.

The most progressive manufacturer can give you the best service. The manufacturers represented in these pages are leaders in their industry; patronize them and mention MODERN MACHINE SHOP when doing so. You will benefit.

Tests Indicate Fitness

(*Continued from page 30*)

realized that no tests can produce results that will be 100 per cent perfect from the standpoint of the employer, and if he expects perfect results he is bound to be disappointed.

So much has been claimed for these tests in the past by over-enthusiastic advocates that they have come to be looked upon by some people with suspicion, but this attitude is no more justifiable than over-optimism. Well-developed and thoroughly-tried tests form, without doubt, an important tool and one that can be used by the employer to the advantage of all concerned. Used intelligently, such tests will easily prove their worth.

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A Screw Driver appropriately named "Super-Grip" because of deep machine cut flutes in clear maple handle — not shallow, rolled-in grooves. The grip of oil-covered hands will hold. The handle has a clear lacquer finish.

HIGH CARBON STEEL BLADE

The blade is high carbon steel hardened throughout, even up into the handle. The positive method of fastening blade prevents turning, the bushing at end of ferrule, welded to blade, keeps handle from working down. Large driving plug at head of handle is especially rigid construction.

FINGERS WON'T SLIP ONTO BLADE

Another outstanding feature of this "new deal" Screw Driver is the ferrule, so designed to prevent slipping of fingers onto blade. The hexagon shape prevents driver from rolling. The ferrule—a solid casting—is self-locking and positively guaranteed against turning in handle or working loose.

Write for Circular and Prices

The FORSBERG MFG. Co.

BRIDGEPORT, CONN.

Over the Editor's Desk

Have You Signed?

THE war against Depression is on. Industry after industry has signed the NRA codes and already the effects are evident everywhere. The enemy is on the run; let everyone take up the pursuit.

The above reference is not far-fetched; the nation is in a state of war. An extreme emergency exists. The nation is in danger. Not danger of invasion by a foreign army, but danger, nevertheless. If an invading army entered our land, took our wealth, stopped the operation of our factories, destroyed a large number of our homes, took away all except the barest necessities of life, and demoralized the industrial and economic system of the country, it could make the situation little—if any—worse than it has been in the last couple of years.

The nation is facing a crisis, to combat which the President has invoked extreme measures. He has asked the various industries to work out codes which will bring the greatest good to the greatest number, and then sign individual agreements to abide by those codes. It is not expected that such a step can be taken without adverse effect in certain individual cases, but one thing is certain—without concerted action there can be no victory.

When the nation goes to war, everyone is fully aware that certain individuals will be sacrificed for the benefit of the whole. Yet this knowledge has never prevented any army from going into battle. The objective is all that counts, and the means justifies the end. The war against the depression is as important as a war against a foreign invader would be. The campaign as planned depends upon the success of the National Industrial Recovery Act, and the success of that Act depends upon united action. Sign your code and be ready to go over the top with the rest of your industry.

The Publishers' Code

AS originally drafted, the Code of Fair Practices for the Periodical Publishing Industry contained a paragraph under the heading "Responsibilities To Advertisers" with which the publishers of MODERN MACHINE SHOP were in full accord.

The paragraph read ". . . The publisher of each periodical shall publish in the first issue of such periodical after April 30th and October 30th of each year a sworn statement showing the average number of copies per issue of such publication sold and distributed during the preceding calendar six months' period ending December 31st and June 30th respectively. Such statement shall also show the percentage relationship of the copies actually sold and the copies distributed free. . . ."

The copy of the Code that MODERN MACHINE SHOP signed contained the above paragraph. In the final draft of the Code, this paragraph was omitted. We would like to ask "Why." The answer might be interesting not only to us, but also to the advertisers—and the advertisers are paying the freight.

As publishers of a national magazine, we take the stand that the buyer of advertising space is entitled to know what he is paying for. So far as the buyer of space is concerned, the teeth have been taken out of the Publishers' Code. With some of the papers in this field retreating from their previous stand and taking up a position of half-paid and half-controlled circulation, the fog is becoming increasingly thick for the space-buyer. In accord-

ance with our stand in the matter, we are publishing, on this page, the Post Office receipts for the August issue, showing the number of copies of MODERN MACHINE SHOP that are being placed in the mails monthly at the present time. And there can be no question regarding these figures; these are United States Post Office receipts, and the figures shown on them cannot be juggled.

There is no fog here.

United States Post Office Receipts

Showing Circulation of MODERN MACHINE SHOP

FOR AUGUST, 1933

6¼ pieces per pound
33 pounds
Pieces 200

6¼ pieces per pound
279 pounds
Pieces 1,743

6¼ pieces per pound
3,692 pounds
Pieces 23,075

Total — 25,018

Copies mailed to foreign countries—stamps affixed 46

Copies mailed in U. S. A.—stamps affixed 93

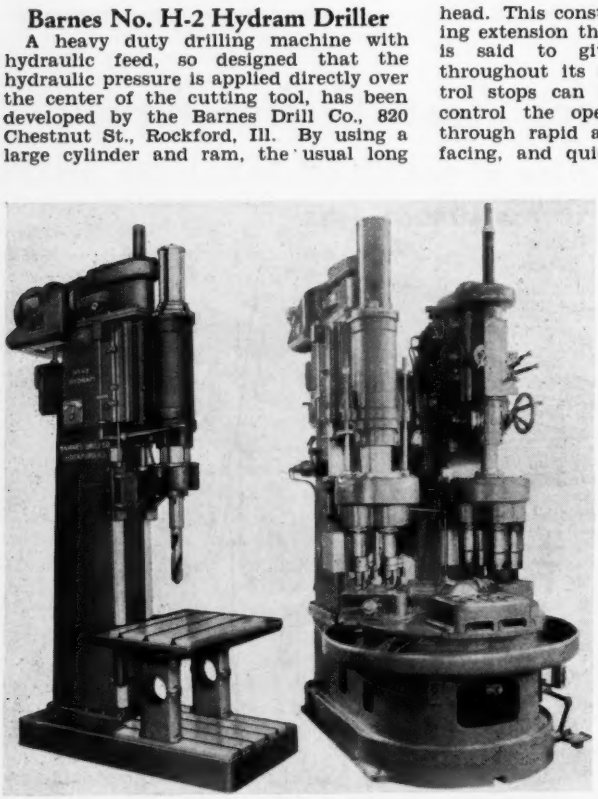
Grand Total 25,157

NEW SHOP EQUIPMENT

Barnes No. H-2 Hydram Driller

A heavy duty drilling machine with hydraulic feed, so designed that the hydraulic pressure is applied directly over the center of the cutting tool, has been developed by the Barnes Drill Co., 820 Chestnut St., Rockford, Ill. By using a large cylinder and ram, the usual long saddle on the column ways for maintaining alignment has been eliminated, and short saddle on the column taking the torque of the drive shaft.

The hydraulic cylinder, large ram, and spindle comprise an individual unit. The large diameter guide bearings, widely separated, afford rigid support for the ram which carries the spindle or multiple head. This construction of the ram, having extension through the upper bearing, is said to give tremendous rigidity throughout its entire travel. The control stops can be set to automatically control the operation of the machine through rapid approach, feed, dwell for facing, and quick return. The volume regulator is at hand to change feeding rate to faster or slower as desired. The machine will drive a 2-in. drill in solid mild steel at a smooth, steady rate of feed and speed.



(Left)—Barnes No. H-2 Hydram Driller. (Right)—No. H-2 Hydram Construction Two-Spindle Progressive-Type Production Unit.

The machine as shown at the left in the illustration has a swing of 24 in., and greater swing may be provided upon request. The height of the drill is 120 in.; distance from face of column to center of table, 12¼ in.; maximum distance from No. 5 taper spindle to standard table, 31¼ in.; maximum distance from spindle to base, 46½ inches.

The working surface of the standard table is 26x18 in. Diameter of the spindle at the six-splined driving end is 2⅛ in.; diameter of the spindle nose, 2⅛ in. Diameter of ram, 6¾ in. Vertical travel of spindle, 16 in.; vertical type of table, 23 in. Floor space required, 50x35 in. Motor recommended to work up to 2 in. steel, 7½ h.p., 1800 r.p.m. Weight, with coolant pump and motor, 4,400 pounds.

At the right in the illustration is shown a Two-Spindle Progressive Type Production Unit, fitted with 4-spindle heavy duty auxiliary heads. The machine is of the No. 2-H Hydram construction, with all hydraulic control from the foot pedal

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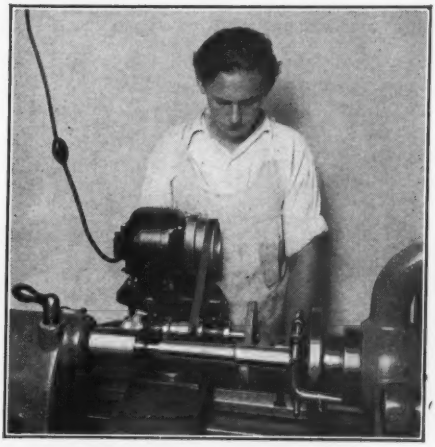

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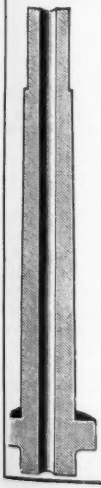

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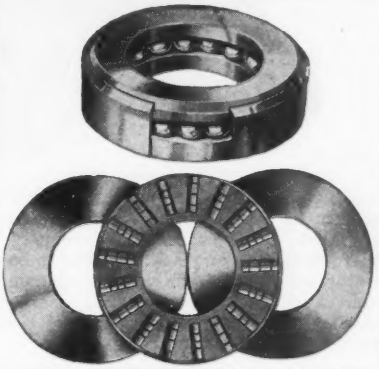

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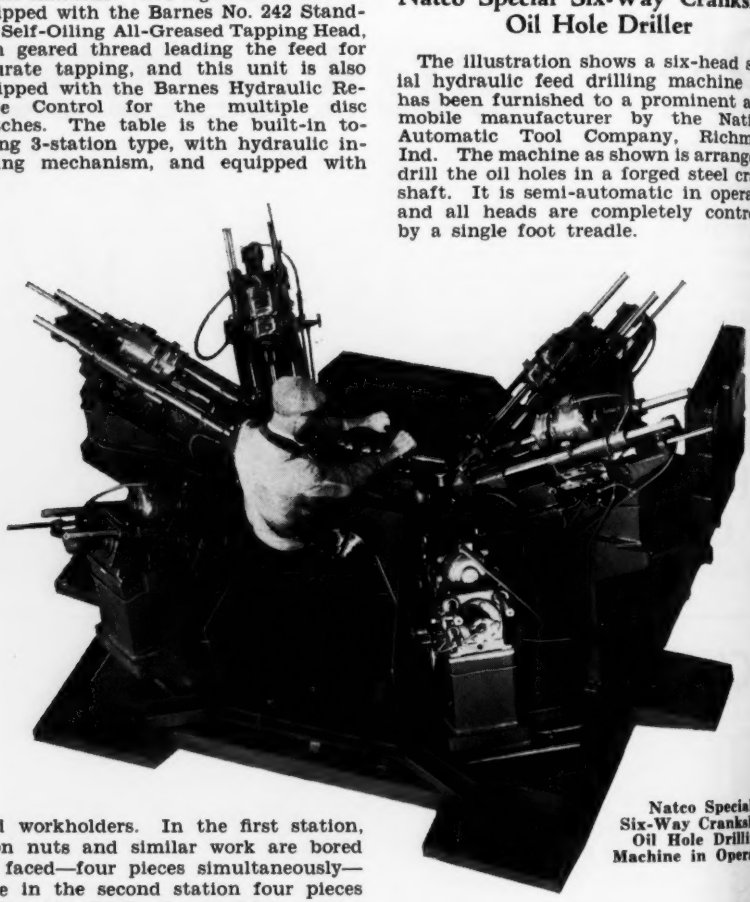
of the machine. The right hand unit is equipped with the Barnes No. 242 Standard Self-Oiling All-Greased Tapping Head, with geared thread leading the feed for accurate tapping, and this unit is also equipped with the Barnes Hydraulic Remote Control for the multiple disc clutches. The table is the built-in totating 3-station type, with hydraulic indexing mechanism, and equipped with quad workholders. In the first station, union nuts and similar work are bored and faced—four pieces simultaneously—while in the second station four pieces are tapped. While the machining operations are in process, the operator changes work in the extra fixtures. All fixtures are air-operated.

Surrounding the table is a wide coolant and chip trough in which a chip sweeper circulates, rotating with each indexing of the table and sweeping the chips to the rear where they fall into a receptacle. At each indexing each spindle rapidly approaches the work, feeds at a predetermined rate as per setting or as per pitch of tap to the desired depth, dwells for facing if required, and backs away at rapid speed.

Natco Special Six-Way Crankshaft Oil Hole Driller

The illustration shows a six-head special hydraulic feed drilling machine that has been furnished to a prominent automobile manufacturer by the National Automatic Tool Company, Richmond, Ind. The machine as shown is arranged to drill the oil holes in a forged steel crankshaft. It is semi-automatic in operation and all heads are completely controlled by a single foot treadle.



Natco Special Six-Way Crankshaft Oil Hole Drilling Machine in Operation

Each unit of the machine is equipped with a single spindle arranged with nose adjustment. A special valve and trip mechanism permit automatic variation of drilling depths, making possible the step drilling of the deep holes in the crank shaft. This feature permits the relieving of chips and the cooling of the drills during the drilling operations. In addition to longer drill life, a cleaner hole is obtained.

The fixture furnished with this machine is of the 4-position trunnion type and is arranged to hold one crankshaft in each position. The base is of welded

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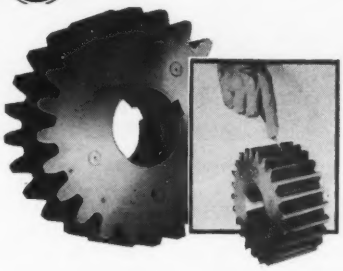

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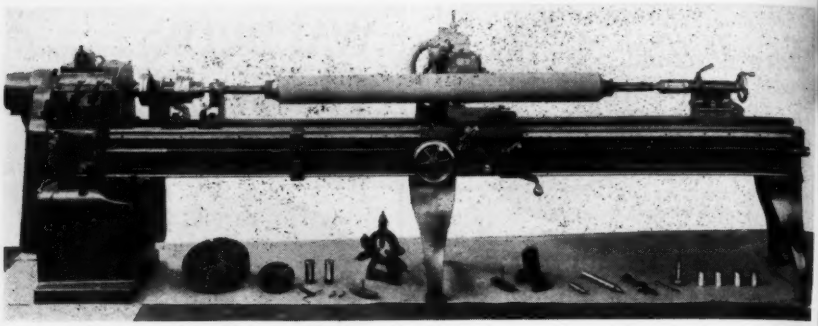

Sebastian Special Maintenance and Rubber Roll Grinding Lathe

construction, and forms a reservoir for the hydraulic and coolant systems. A production of 25 crankshafts per hour is obtained with this machine.

The weight of the machine is approximately 17,000 pounds.

Sebastian Special Maintenance and Rubber Roll Grinding Lathe

The increase in the reconditioning of rubber rolls for newspaper and magazine work has led to the development, by The Sebastian Lathe Company, Cincinnati, Ohio, of a lathe especially designed for maintenance work and particularly for the regrinding of such rolls. The roll grinding operation is facilitated by the use of special attachments which can be removed in a few minutes, thus reducing the machine to a standard lathe of the dimensions that are best adapted for maintenance work.

The lathe has a swing of 16¼ in., and the bed is 14 ft. long. The distance between centers is 133½ in. The lathe is equipped with an eight-speed geared head, a quick change gear-box motor drive with switch, and apron control for starting and stopping.

Equipment includes special brackets for holding the roll while grinding, special spindle and split hinged bearings for tailstock and headstock, wheel truing attachment with a star dresser, electric grinding attachment with suction exhaust, special collet chuck and three collets of 1-in., 1¼-in., and 1½-in. sizes. The bushings and journals into which the rolls are laid are split and hinged so that the operator simply lifts the roll into the lathe and lays it in the bushings, which are duplicates of the press bearings. The collet selected depends upon the size of the roll end.

The method intended to be followed consists in grinding the roll first, using the electric grinder, then polishing the roll by hand. To switch from grinding to polishing it is only necessary to release the grinding mechanism at the headstock end of the lathe, then slip into place a belt which connects the motor with the spindle pulley, thus obtaining a speed of 1200 r.p.m. It is said that a

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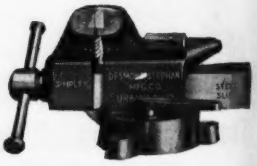

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roll finished in this manner will show no grinding wheel marks when examined with a magnifying glass. The approximate time for grinding and finish polishing a roll 6 in. diameter by 72 in. long is 1¼ hours.

For grinding, a rubber bonded wheel of coarse grain is supplied, with instruction for its use in the grinding of rubber. The suction exhaust draws off practically all of the waste material. For polishing, the operator covers the roll with powdered soapstone, then operates the machine at high speed while polishing the roll with aluminum oxide-coated cloth of 120-180 grit. The cloth is held on by hand, with a piece of leather between the operator's hand and the polishing cloth.

The lathe described above can also be had in 14-ft. bed length, with 20-in. swing.

H-P-M Self Contained Hydraulic Presses

A modern edition of a familiar form of hydraulic platen press has been introduced by The Hydraulic Press Mfg. Co., Mount Gilead, Ohio. This press consists of the regulation upward-acting type of press frame with its own individual hydraulic power plant, thus forming a compact, self contained motorized machine.

The hydraulic operating pressure is generated by an H-P-M "Hydro-Power" unit, consisting of the H-P-M variable delivery radial pump with direct connected electric motor, mounted together on a base enclosed for containing the oil used as pressure fluid and lubricant. This unit can be mounted in any convenient location adjacent to the press at the side or rear. The pressure exerted by the press and its speed of ram travel

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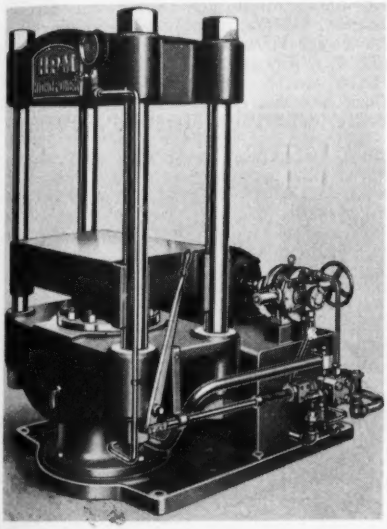
are subject to close automatic regulation, through controls governing the output of the power unit.

Among the advantages attending the installation of the self-contained H-P-M "Hydro-Power" press over conventional hydraulic presses operated from a central accumulator system are said to be savings in installation cost, savings in floor space, no restrictions on location, no need of



H-P-M Self-Contained Hydraulic Press with "Hydro-Power" Unit at Rear

attempting to provide for hypothetical future hydraulic power requirements.

Operating features of the H-P-M "Hydro-Power" press include automatic pressure regulation with adjustable pressure capacity, variable working speed, low operating costs with power consumption proportional to the effective work performed by the press.

The illustration shows the basic model of this line of presses, mounted on a bed plate with the "Hydro-Power" unit at the rear. This type of press is employed for many different kinds of forming operations and may be equipped with various types of pressing fixtures extending its utility. The basic press may also be arranged with an intermediate pressing platen, thus providing two presses in one. This press is especially fitted for plastic molding service, being equipped with die

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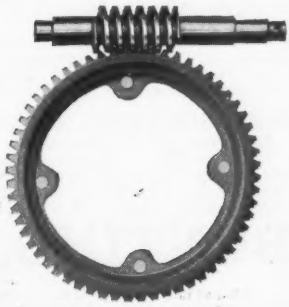

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bolsters and ejectors for "semi-automatic" or fixed multiple cavity molds.

This line of presses is available in standard pressure capacities of 25, 50, 75, 100, 150, 200, 250, 300, 400 and 500 tons, each with square or open side platens varying in increments of 12 inches.

Improved Design of Layth-Grindar

The "Layth-Grindar", a precision grinding attachment for use with lathes, shapers, millers, or planers, and made by the Layth-Grindar Corporation, 30 Canfield St., Orange, N. J., has been redesigned to incorporate some features which are said to improve the operation of the tool. The motor base and spindle

Improved Design of Layth-Grindar

bearing are now cast in one piece, eliminating the necessity for joints. The forward (right-hand) spindle bearing is a long, pre-glazed cast iron sleeve, ground to a taper and lapped to a perfect contact with the spindle. The rear (left-hand) bearing is a tapered, four-slotted phosphor bronze sleeve ground to a perfect spindle fit, with an accurate compression adjustment for wear. A ball thrust bearing holds the spindle to a perfect seat in the taper sleeves. Steel locknuts maintain the adjustments and make it possible to remove the spindle without disturbing the bearings.

The load on the spindle bearing is equalized and tendency to spring the spindle is avoided by mounting the spindle pulley between the bearings, as shown. Belt adjustment is obtained by moving the motor in its bearings by

means of a screw. A setscrew provides for locking the motor in position.

The Layth-Grindar is powered by a low-speed motor (1725 r.p.m.) on all the engine lathe sizes except the ⅛ h.p. unit, where the motor speed is 3450 r.p.m. These speeds are stepped up to the desired spindle speed, so that the speed of the spindle is always higher than that of the motor, thus avoiding vibration. In two smaller sizes, two-step cone pulleys have been found to provide all the speed range necessary. On all engine lathe sizes except the 1 h.p. unit, three-step cone pulleys are used; thus by reversing the spindle pulley, five different speeds are available. It is not necessary to change the belt and pulleys with each change of wheel diameter.

Each Layth-Grindar is shipped complete in a container with handles, which also contain all the arbors, wrenches and other equipment used in connection with the tool.

Grand Rapids No. 3-V Hyd. Feed Vertical Spindle Surface Grinder

Inasmuch as there are many classes of work for which a vertical spindle grinding machine with a cup wheel would be ideal, the Gallmeyer & Livingston Co., Grand Rapids, Michigan, has brought out the machine shown in the illustration. This machine—the Grand Rapids No. 3-V Hydraulic Feed Vertical Spindle Surface Grinder—is designed to incorporate all the advantages of hydraulic feed, making it possible to use a rapid table travel for roughing cuts and a slower travel for the light finishing cuts. Speeds from as slow as 2 ft. per min. to well over 100 ft. per min. are available.

The column and base of the machine are cast integral, assuring the utmost rigidity. The head with its motor and spindle assembly is a very rigid unit, designed to eliminate vibration and thus reduce wheel wear to the minimum. To facilitate the movement of the head, a motor-driven power rapid traverse mechanism is supplied, controlled by means of a double-throw switch with magnetic throw-out to neutral position that is connected with a reversing motor. Automatic down feed variable from 0.0001 in. to 0.002 in. per stroke with automatic throw-out is provided.

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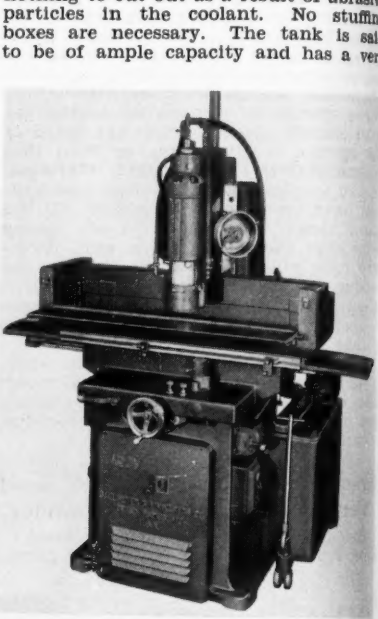
cycle motor with ample overload capacity is mounted directly on the spindle. There are no belts. The hydraulic pump is driven direct from a 1½ h.p. motor mounted in the base of the machine, also without belts.

A detachable portable coolant system provides a copious flow of coolant. The portable tank is positioned on the floor against the base of the machine. The cover of the tank carries a vertical ball bearing motor, upon the shaft of which is mounted a spider-type vane pump. No bearings are under water and there is nothing to cut out as a result of abrasive particles in the coolant. No stuffing boxes are necessary. The tank is said to be of ample capacity and has a vertical partition rising to within about 4 in. of the top, forming the compartment into which the pump sets. The compartment occupies between one-fourth and one-third of the entire tank capacity; the rest of the tank has an angular baffle plate which extends from the top of the tank downward to within about 4 in. of the end of the tank, forcing any abrasive particles which reach the pump to



Grand Rapids No. 3-V Hydraulic Feed Vertical Spindle Surface Grinder

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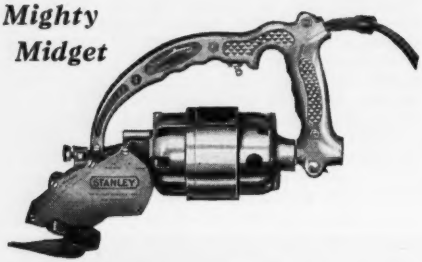

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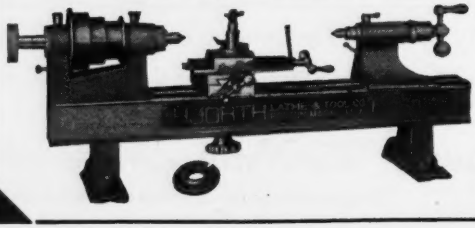

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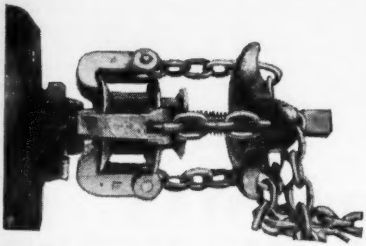
pass under the baffle and over the pump partition.

The portable feature provides maximum convenience in cleaning the tank. To clean it, the cover is lifted off complete with the small ¼-h.p. motor and pump mechanism, then the tank is quickly detached from the machine and moved to a suitable place for cleaning and refilling. A one-shot lubrication system that reaches all parts and location requiring oil is provided. The spindle is lubricated with grease, by means of grease cups.

"Steelgrip" Universal Gear and Wheel Puller

A universal puller for wheels, gears, pulleys, bushings, and pinions, to be known as the "Steelgrip" universal Gear and Wheel Puller, has been placed on the



"Steelgrip" Universal Gear and Wheel Puller

market by Armstrong-Bray & Co., 310 Sheldon St., Chicago, Ill. The chief advantage claimed for this tool is its universality and the range of work that can be handled with its aid.

Consisting of a heavy bracket with a large pulling screw and three chains of practically any desired length, it will handle work at any distance from the

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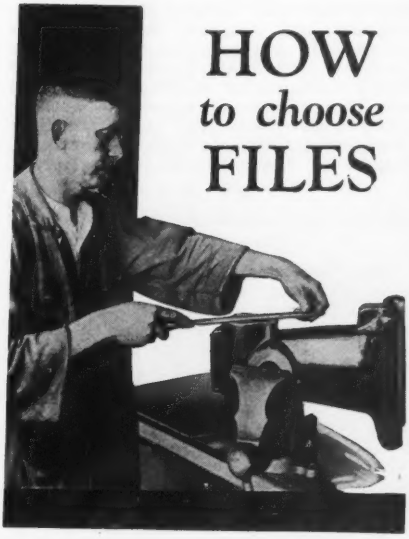

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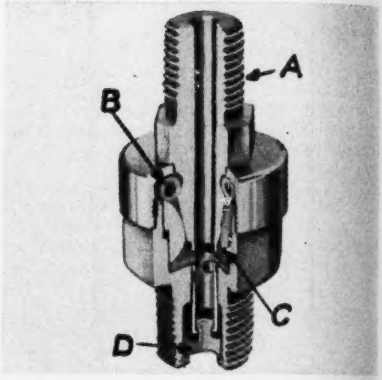
end of the shaft. The chains have double ends, with standard chain hooks for gripping around spoked wheels or large gears on one end and special hooks that take a close grip for bushings, small gears or motor pulleys, or where the working space is restricted. The pulley comes in two sizes with pulling capacities of 12,000 pounds or 36,000 pounds respectively.

Meyer Air Coupling with Automatic Shut-off Valve

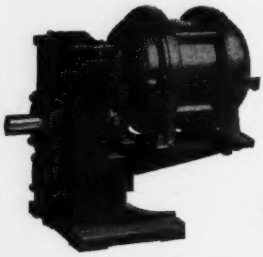
The illustration shows a cross-section view of an air coupling that has been brought out by the Spear-Tap Manufacturing Co., Los Angeles, Cal., and is being marketed east of the Rocky Mountains by the Plath-Fittinger Co., 1900 East Jefferson Ave., Detroit, Michigan. The feature of the coupling consists in that it can be connected by a simple push and disengaged by a straight pull while in service, although the greater the pressure of air in the coupling, the greater the grip of the spring which holds the two parts of the coupling together.

The cross-sectional view of the coupling illustrates the principle upon which the coupling operates. The pressure built up in the coupling by the flow of air, gas



Meyer ⅜-In. Air Coupling

oil, or water causes the floating piston C to move forward and against the spring B. The piston thus compresses the spring, causing it to grip the groove in the semi-conical head of the spud A tightly. As the pressure increases, the spring grip also increases, with the result that it is almost impossible to separate the coupling when high pressure exists.



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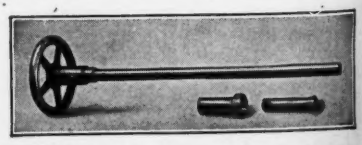

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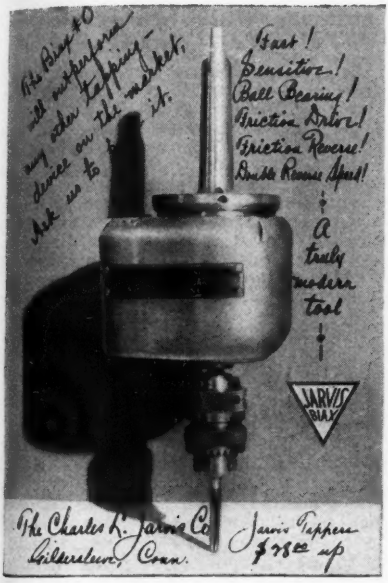

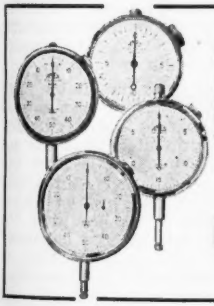

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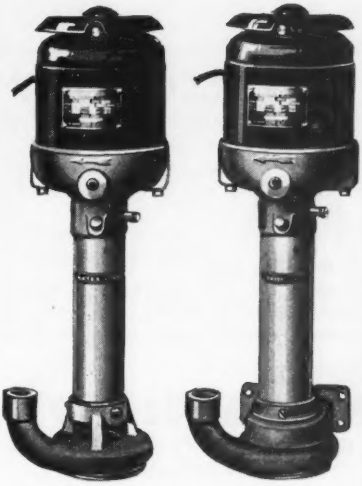

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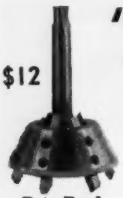

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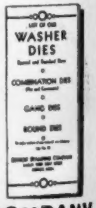

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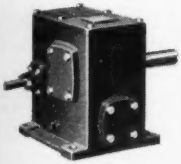

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Motorize Your Cone Pulley Lathes: An attachment that can be applied to your lathe with four bolts makes it possible to motorize and modernize your lathes. Write for information to Cullman Wheel Co., 1336 Altgeld St., Chicago, Ill.

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